TRANSLATION (HM-597PCT -- IPER):

TREATY ON INTERNATIONAL COOPERATION IN THE AREA OF PATENTS

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(Article 36 and Rule 70 of the PCT)

Applicant's or Agent's File Ref. 40 834.%.nb	**FOR FURTHER ACTION**	See Notification of Transmittal of the International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. PCT/EP03/01999	International Filing Date *(Month/Day/Year)* February 27, 2003	Priority Date *(Month/Day/Year)* April 6, 2002
International Patent Classification (IPC) or National Classification and IPC B21B45/02		
Applicant SMS DEMAG AKTIENGESELLSCHAFT et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 pages, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., pages of the description, claims, and/or drawings which have been amended and are the basis for this report and/or pages containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 pages.

3. This report contains indications relating to the following items:

I	☒	Basis of the report
II	☐	Priority
III	☐	Non-establishment of opinion with regard to novelty, inventive activity, or commercial viability.
IV	☐	Lack of unity of invention.
V	☒	Substantiated determination under Rule 66.2 a(ii) with regard to novelty, inventive activity, or commercial viability; citations and explanations supporting such statement.
VI	☐	Certain documents cited
VII	☐	Certain defects in the international application
VIII	☐	Certain observations on the international application

Date of submission of the petition: October 21, 2003	Date of completion of this report: July 6, 2004
Name and mailing address of the office assigned to perform the preliminary examination: European Patent Office D-80298 Munich Tel: +49 89 2399-0 Tx: 523656 epmu d Fax: +49 89 2399-4465	Authorized Officer: Rechler, W. Tel: +49 89 2399-2354

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International File No.: **PCT/EP03/01999**

I. Basis of the Report

1. With regard to the **constituent parts** of the international application (*replacement pages which were submitted to the application office in compliance with a request according to Article 14 are considered "originally filed" in the context of this report and are not attached to the report, because they do not contain any changes (Rules 70.16 and 70.17)):*

Specification, pages:

1, 3-7	as originally filed
2, 2a	received on April 15, 2004 with letter dated April 4, 2004

Claims, Nos.:

3-15	as originally filed

Drawings, Pages:

1/6-6/6	as originally filed

2. With respect to the **language,** all the constituent parts marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise cited under this item.

The constituent parts were available or furnished to this Authority in the following language: . . . . . which is:

☐ the language of a translation furnished for the purpose of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purpose of international preliminary examination (under Rule 55.2 and/or Rule 55.3).

3. With regard to the **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer-readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer-readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer-readable form is identical to the written listing has been furnished.

4. The amendments have resulted in the cancellation of:

☐ the description, pages:

☐ the claims, Nos.:

☐ the drawings, sheets/figures:

5. ☐ This report has been prepared as if (some of) the amendments had not been made, since for the specified reasons they are considered by this Authority to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Any additional remarks:

V. Substantiated determination according to Article 35(2) with respect to novelty, inventive activity, and commercial viability; documents and declarations in support of this determination.

1. Determination

Novelty (N)	Yes:	Claims 1-15
	No:	Claims
Inventive Activity (AI):	Yes:	Claims 2-15
	No:	Claims 1
Commercial Viability (CV):	Yes:	Claims 1-15
	No:	Claims

2. Documents and Declarations

See attached page.

Section V

1. The following documents are cited:

D1: DE-A-198 43 038

D2: JP-A-06212278

D3: JP-A-11226625

2. The present application does not fulfill the requirements of Article 33 PCT, because the object of Claim 1 is not based on inventive activity in accordance with Article 33 (3) PCT.

The amendments and arguments submitted with the letter of April 14, 2004 fail for the following reasons:

3. Document D1, which is regarded as the closest prior art, discloses a device, from which the object of Claim 1 differs only to the extent that the rollers of the roller table have elongated pins of small diameter.

However, this feature was already been used for the same purpose in a similar device; cf. document D3, especially **Figures 3 (and 1), in which the elongated pins are clearly shown**. If a person skilled in the art wishes to achieve the same purpose in a device in accordance with the document D1, it is immediately possible for him to use this feature with corresponding effect in the object of D1 as well. In this way, he would arrive at a device in accordance with Claim 1 without any inventive effort. Therefore, the object of Claim 1 is not based on inventive activity (Article 33 (3) PCT).

Moreover, the characterizing features, " .... that the rollers of the roller table are arranged with the closest possible spacing; that the lower cooling bars are arranged below the spaces remaining between the rollers; and that the spray tubes (13) of the cooling bars (2) fit into these spaces .... " are also already known from document D2 (**cf. especially Figures 2 and 4**). In this regard, it must be noted **that "closest possible" is a relative term and -- if necessary -- can also mean relatively far apart**.

3. The combination of features contained in dependent Claims 2–4 is neither known from the present state of the art nor suggested by it. An independent claim which would combine the features of present Claims 1–4 would satisfy the requirements of the PCT with respect to novelty and inventive activity (Article 33 (2) and (3) PCT).

Claims 5–15 could follow an independent claim of this description and thus likewise satisfy the requirements of the PCT with respect to novelty and inventive activity.

4. Commercial viability in the steel industry is self-evident.

Other Comments:

Contrary to the requirements of Rule 5.1 (a)(ii), the specification fails to disclose the relevant prior art disclosed in Document D3 as well as document D3 itself. Documents D1 and D2 are inadequately acknowledged with respect to the object of the independent claim.

**Translated Text of WO 03/084,686 A1 (PCT/EP03/01999)
with Amended Pages and Amended Claims Incorporated Therein**

DEVICE FOR COOLING ROLLING STOCK WITHIN THE COOLING LINE OF A ROLLING MILL

The invention concerns a device for cooling rolling stock within the cooling line of a rolling mill, especially a hot strip rolling mill, in which stationary water spray devices are installed below the rolling stock between the rollers of a roller table, and spray bars held on support levers are installed above the rolling stock, wherein the support levers are supported by a tubular, rotationally driven and water-fed articulated tube that extends parallel to the longitudinal axis of the roller table, with a central water feed pipe and an automatic control device with associated on-off valves for switching the cooling water on and off.

Devices for cooling rolling stock are permanent parts of every rolling mill. They have become more important since certain metallurgical states, e.g., grain sizes, and the high working stress of the rolled product associated with these metallurgical states have been strived for by influencing the

transformation of the steel.

For example, EP 0 178 281 B1 describes equipment for cooling a metal product with flat upper and lower sides, especially sheet metal, which is moved on a roller conveyor, wherein coolant for the lower side is fed into the gaps formed between the rollers of the roller conveyor, and another device is provided above the rolling stock, whose distance from the rolling stock can be varied. Disadvantages of this well-known cooling equipment are the comparatively high material expense and especially the costly on-site installation work, which results in relatively high construction costs.

DE 198 43 038.8 A, which may be regarded as the model for devices of this type, describes a device for cooling rolling stock, in which spray bars that deliver cooling water from above are supported in such a way that they can swivel and are partially balanced by counterweights to simplify the operation. By combining the cooling water feed lines, the resulting installation costs can be favorably affected.

Although JP 06[1994]-212,278 discloses a rolled strip cooling device that has stationary water spray devices installed between rollers of a roller table, by means of which the rolled

strip can be cooled from the underside, it does not propose any measures for maximizing the cooling capacity and shortening the roller table.

The objective of the invention is to further increase the maximum cooling capacity that can be achieved, but at the same time to shorten the length of the roller table required for this to obtain a compact design and a high cooling capacity.

This objective is achieved by the measures specified in Claim 1. Modifications of the cooling device of the invention are specified in the dependent claims.

The features of the invention are explained in detail in the following description of the embodiment of the invention illustrated in the drawings.

-- Figure 1 shows a longitudinal section of the compact design of the cooling system with a conveyor roller table, a strip guide, and longitudinal strip spraying devices.

-- Figure 2 shows a cross section of the cooling system in Figure 1 with conveyor roller table, strip guide, and swiveling device for the upper spray bars.

-- Figure 3 shows the same cross section of the roller table as in Figure 2 but drawn to a slightly smaller scale and

with the spray bar raised.

-- Figure 4 shows a top view of a section of the roller table with a system for guiding the strip.

-- Figure 5 shows a schematic vertical section of a spray bar with spray tube plate and spray tubes.

-- Figure 6 shows a vertical longitudinal section of one of the lower cooling bars.

-- Figure 7 shows a schematic cross section of two adjacent rollers of a roller table with lower cooling bars with spray tubes provided between and under them.

Figure 1 shows a roller table modified into a compact cooling device. Lower cooling bars 2 are seen slightly below the gaps between the rollers of this roller table 1. Spray bars 3, which are terminated at the bottom by interchangeable spray tube plates 4 with spray tubes, are shown above the roller table. Swiveling spray guard plates 5 articulate with the spray bars 3 and are designed to protect the surrounding area from sprayed water and to ensure that used spray water flows downward. The drawing also shows strip guide straightedges 6, which serve to align and centrally guide the hot strip running into the roller table.

The arrangement of the cooling bars, spray bars, and strip guide straightedges is shown in detail in Figure 2, which is drawn to a larger scale and shows a cross section of the roller table 1 in the center plane of a lower cooling bar.

The cooling bar 2 is closed at both ends by caps 7, which can be removed, for example, for cleaning. The cooling bar 2 is fed through a cooling water pipe 8 via a manifold 9. The rollers 10 of the roller table 1 are provided with long, slender pins 11, which support the rollers in bearings and transmit the drive from the roller table motors 12. The rollers 10 are arranged with very narrow spacing, and the spray tubes 13 of the cooling bar 2 fit into the narrow spaces between them. However, this allows only small amounts of cooling water to flow off between the rollers 10; all the more space is offered for the water to flow off between the long, slender pins 11 of the rollers 10.

In this connection, the strip guide straightedges 6 are shown again in this drawing. The guide straightedge shown on the left is pulled back for maximum strip widths or for a home position and thus opens the area of the pins of the rollers for water to flow off from the very start. On the other hand, the

guide straightedge shown on the right is pushed extremely far forward and thus largely covers the runoff route formed between the pins 11 of the rollers 10. Therefore, during practical operation, when the strip is run in, the strip guide straightedges 6 are set to the width of the strip that is running in, and after the strip has been run in, the cooling system is turned on, and the strip guide straightedges are pulled back into their home position of maximum opening.

The placement of the upper spray bar 3 is also shown in the drawing. A rotating articulated tube 15, which is fed with cooling water in the axial direction, is supported by means of one or more stands 14. Tubular support arms 16, into which the cooling water of the articulated tube 15 can enter, are connected to the articulated tube 15. Two parallel spray bars 3 are connected to each of these support arms and are supplied with cooling water through the tubular support levers 16. On the underside, the spray bars 3 are supplemented by interchangeable and adaptable spray tube plates 4, and the free ends support the articulated spray guard plates 5. Each of the support levers is supported by a hydraulic cylinder 17 and can be swung upward by the hydraulic cylinder from its working

position shown in Figure 2 into the position shown in Figure 3 to perform repairs and inspections or to allow strips to be removed from the roller table.

Figure 4 shows a top view of the strip guide straightedges 6 of the roller table. The two adjusting devices 18 for the guide straightedges 6 have adjusted to a narrow strip width, so that the straightedges are above the cylindrical surfaces of the rollers 10 themselves: As has already been explained, after the strip has been run in, the guide straightedges 6 are opened to their maximum extent, so that the relatively large spaces formed between the pins 11 of the rollers 10 are able to carry off the cooling water delivered by the spray bars 3 and possibly by the cooling bars 2.

The design of the spray bars 3 is illustrated in Figure 5, which shows a cross section on a larger scale. The drawing shows a spray tube plate 4 mounted below the spray bar 3 and a number of spray tubes 20. As the enlarged detail drawings show, the free, water-carrying mouth region 21 of the spray tubes 20 is expanded like a funnel to allow the water flowing in to be carried without throttling. On the other hand, the discharge region 22 is either cylindrical or constricted, usually only

slightly, but in any event to the extent required to achieve the desired spray velocity. There are several mounting possibilities: The spray tubes 20 can be mounted in the spray tube plate 4, or they can be designed to be replaceable, in case a change or replacement becomes necessary due to wear or due to the need to use different dimensions.

Figure 6 again shows one of the lower cooling bars 2 in a side view. The removable caps 7 that seal the cleaning or inspection opening and the manifold 9 for connecting the cooling water pipe 8 of Figures 2 and 3 are also shown here.

However, as especially Figure 7 shows, the space formed between two adjacent rollers 10 of the roller table 1 is very narrow, so that the supply of cooling water from below and the drainage of the cooling water running off from above become critical in such a compact arrangement. This problem is solved here by arranging the actual body of the cooling bar 2 below the center horizontal lines of the rollers 10 and at the same time providing a pear-shaped design of the cross section of the cooling bar in the direction of the streamlined body. This body is terminated above by a retaining strip 23, whose bores hold the spray tubes 13, which terminate at their upper end in a

nozzle 24 that determines their spray pattern.

As Figure 1 shows, the compact cooling system is supplemented by longitudinal spray devices 25 and 26, which can be swiveled and switched, at the inlet and outlet ends. These ensure that the cooling water present on the upper side of the strip due to the delivery of abundant cooling water cannot flow or be conveyed by the strip into the area of the technological measuring instruments, where they would distort or falsify the measurement results. These longitudinal spray devices 25 and 26 consist of swinging flaps 27 and 28 with nozzle tubes 29 and 30. When the strip is being run in, the flaps are swung up to ensure trouble-free passage of the strip. The flaps 27, 28 are then lowered for operation, and the nozzle tubes 29, 30 are turned on. After the flaps and nozzle tubes have been lowered, the nozzles are located directly above the surface of the strip to ensure effective nozzle jet action. The flaps protect the nozzles and can turn upward in the event of problems with the strip flow, e.g., looping, without any significant damage to the longitudinal spray devices.

Reference Numbers

1	roller train
2	lower cooling bar
3	upper spray bar
4	spray tube plate (3)
5	spray guard plate
6	strip guide straightedge
7	cap (2)
8	cooling water pipe (2)
9	manifold (2)
10	roller (1)
11	pin (10)
12	motor (10, 11)
13	spray tube
14	stand
15	rotating articulated tube
16	support lever (15)
17	hydraulic cylinder (16)
18	adjusting device (6)
19	stop (6)

20	spray tubes
21	mouth region
22	discharge region (19)
23	retaining strip (2)
24	nozzles (13)
25, 26	longitudinal spray systems
27, 28	flaps (25, 26)
29, 30	nozzle tubes (25, 26)

CLAIMS

1. Device for cooling rolling stock within the cooling line of a rolling mill, especially a hot strip rolling mill, in which stationary water spray devices are installed below the rolling stock between rollers (10) of a roller table (1), and spray bars (3) held on support levers (16) are installed above the rolling stock, wherein the support levers (16) are supported by a tubular, rotationally driven and water-fed articulated tube (15) that extends parallel to the longitudinal axis of the roller table (1), with a central water feed pipe and an automatic control device with associated on-off valves for switching the cooling water on and off, characterized by the fact that the rollers (10) of the roller table (1) are arranged with the closest possible spacing; that the lower cooling bars (2) are arranged below the spaces remaining between the rollers (10); that the spray tubes (13) of the cooling bars (2) fit into these spaces; and that the rollers (10) of the roller table (1) have elongated pins (11) of small diameter.

2. System in accordance with Claim 1, characterized by the fact that the cooling bars (2) have a pear-shaped cross section, whose neck is directed towards the spaces remaining between the rollers (10) and is furnished with the spray tubes (13).

3. System in accordance with Claim 1 or Claim 2, characterized by the fact that the neck of the pear-shaped cross section of the cooling bars (2) is terminated by a retaining strip (23), which is fitted with spray tubes (13) and advantageously is interchangeable.

4. System in accordance with Claims 1 to 3, characterized by the fact that the free end of each spray tube (13) is fitted with a nozzle (24).

5. System in accordance with Claims 1 to 4, characterized by an articulated tube (15), which carries cooling water and is supported by stands (14) or the like in such a way that it can swivel, and from which tubular support arms (16) originate, which convey cooling water and both support the upper spray bars (3) and supply cooling water to them.

6. System in accordance with Claim 5, characterized by at least one drive mechanism associated with the articulated tube (15).

7. System in accordance with Claim 6, characterized by a hydraulic cylinder (17) that acts on a lever connected with the articulated tube (15), for example, a section of a support lever (16).

8. System in accordance with Claims 1 to 7, characterized by spray guard plates (5) that articulate in front of the end faces of the spray bars (3).

9. System in accordance with Claims 1 to 8, characterized by guide straightedges (6), which can be advanced towards stops (19) representing the strip width to be processed and can be retracted to their wide-open home position at the start of the intensive compact cooling.

10. System in accordance with Claims 1 to 9, characterized by the fact that spray tube plates (4) that are provided with spray tubes (20) can be detachably or interchangeably mounted on the underside of the upper spray bars (3).

11. System in accordance with Claim 10, characterized by the fact that the front free ends of the mouth regions (21) of the spray tubes (20) are expanded like funnels, and the lower ends in the discharge regions (22) are constricted, if necessary, to the desired cross section.

12. System in accordance with Claims 1 to 11, characterized by the fact that the ends of the cooling line of the roller table (1) are preferably equipped with systems (25, 26) for longitudinal spraying.

13. System in accordance with Claim 12, characterized by the fact that flaps (27, 28) that can be lowered are installed in front of the longitudinal spray systems.

14. System in accordance with Claim 12 or 13, characterized by the fact that the longitudinal spray systems (25, 26) are equipped with nozzle tubes (29, 30) that are acted upon by pressurized water and/or compressed air.

15. System in accordance with Claim 14, characterized by the fact that the tubes that carry the nozzles can be raised into an open position.